CAPACITIVE SENSOR

BACKGROUND OF THE INVENTION

[0001] 1. Field of the Invention

[0002] The present invention relates to a capacitive sensor, and, more particularly, to a pressure-sensitive capacitive sensor preferably used as a fingerprint sensor.

[0003] 2. Description of the Related Art

[0004] A surface pressure distribution sensor for sensing a fine unevenness is used as a fingerprint sensor or the like. **FIG. 17** shows a related art. As shown in **FIG. 17**, the fingerprint scanning device (i.e. fingerprint sensor) includes a first electrode group **12** consisting of a plurality of verticals extending in a first direction; a second electrode group **14** consisting of a plurality of horizontals extending in a second direction crossing the first direction and disposed on the first electrode group with an interlayer insulating film **13** interposed between the first and second electrode groups; a fingerprint scanning sensor having a surface protective layer **15** made of a dielectric substance disposed on the second electrode group **14**; and driving circuits **18** and **19** applying a predetermined voltage to each of the first electrodes **12** and the second electrodes **14** sequentially, and measuring electrostatic capacitances between the electrodes **12** and **14** and the fingerprint in contact with the surface protective layer **15** so as to measure the change in the electrostatic capacitances near intersections between the first electrodes **12** and the second electrodes **14** (See JP-A-2001-46359).

[0005] In the fingerprint reading device using the above pressure-sensitive capacitive sensor, noises are flowed into a fingerprint detecting unit from a human body via a finger when the finger is pressed to the fingerprint detecting unit in order to scan the fingerprint.

[0006] That is, the noises are flowed in due to parasitic capacitances which occur between the fingerprint and detecting wiring lines at positions where driving wiring lines (vertical electrode) and the detecting wiring lines (horizontal wiring lines) are disposed in a matrix with a vertical gap therebetween and do not cross each other, and the noises cause the degradation of the detecting accuracy.

[0007] The pressure-sensitive capacitive sensor in the related art cannot remove the noises flowed in from the human body.

SUMMARY OF THE INVENTION

[0008] The present invention has been finalized in view of the drawbacks inherent in the capacitive sensor in the related art, and it is an advantage of the invention to provide a pressure-sensitive capacitive sensor capable of easily removing noises delivered from a human body.

[0009] One aspect of the invention is a pressure-sensitive capacitive sensor, including a sensor unit having a first substrate **20** where a plurality of vertical wiring lines **22** is formed; and a second substrate **30** where a plurality of horizontal wiring lines **32** is formed, the first and second substrates being disposed in a matrix and facing each other with a gap therebetween, and the capacitance at the intersections between the vertical wiring lines and the horizontal wiring lines changed according to external pressure; and a detecting unit for detecting the change in the capacitance at the intersections between the vertical wiring lines and the horizontal wiring lines and detecting an externally applied pressure distribution based on the detecting result. In this case, a horizontal wiring line **50** for noise detection is disposed on a surface where the horizontal wiring lines are formed on the second substrate.

[0010] In the above pressure-sensitive capacitive sensor, the first substrate where a plurality of horizontal wiring lines is formed and the second substrate where a plurality of vertical wiring lines is formed face each other with a gap therebetween, and the first and second substrates have a matrix formed by the horizontal and vertical wiring lines, and the horizontal wiring line for noise detection is disposed on a surface of the second substrate where the horizontal wiring lines are formed.

[0011] In addition, the capacitive sensor includes a sensor unit and a detecting unit, and the sensor unit senses the change in the capacitance at the intersections between the horizontal wiring lines and the vertical wiring lines in response to an externally applied pressure, and the detecting unit detects the change in the capacitance at the intersections between the horizontal wiring lines and the vertical wiring, thereby an externally applied pressure distribution is detected based on the corresponding detecting result.

[0012] Therefore, according to the above structure, the area of the horizontal wiring line for noise detection is set almost equal to the sum of the areas of wiring lines (that is, gap areas) where the horizontal wiring lines and the vertical wiring lines do not cross each other, that is, the amount of noises delivered to the horizontal wiring lines from the finger becomes almost equal to the amount of noises delivered to the horizontal wiring line for noise detection from the finger, thereby the amount of capacitances between the finger and the horizontal wiring lines becomes almost equal to the amount of capacitances between the finger and the horizontal wiring line for noise detection when the finger, the detecting target, comes in contact with the sensor unit if the capacitive sensor is used as a fingerprint sensor. As a result, the difference between the amount of noises delivered to each of the horizontal wiring lines and the amount of noises delivered to the horizontal wiring line for noise detection can be taken by signal processing of the detecting unit of the subsequent stage, thereby the noises delivered from a human body can be easily removed.

[0013] In addition, the vertical wiring lines are not disposed at a position facing the horizontal wiring line for noise detection in the capacitive sensor.

[0014] According to the above capacitive sensor, the vertical wiring lines are not disposed at the position facing the horizontal wiring for noise detection. Therefore, the horizontal wiring line for noise detection does not cross the vertical wiring lines, thereby signal components are not flowed into the horizontal wiring line for noise detection from the vertical wiring lines, and when the capacitive sensor is used as the fingerprint sensor, only noises delivered from a human body by the finger can be detected via the horizontal wiring line for noise detection. Accordingly, the structure of the detecting circuit for carrying out the subsequent signal processing can be simplified.

[0015] In addition, in the pressure-sensitive capacitive sensor, the first substrate has flexibility and uses a surface of the first substrate as a contacting surface with a detecting target.